Circular 52 : November, 1914
Third Revision, May, 1924

IMPERIAL BUREAU OF MYCOLOGY
9 DEC. 19

Control Potato Diseases

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High Points in Potato Disease Control

Start with clean seed. Wisconsin certified or inspected seed is preferred.

Treat the seed. Corrosive sublimate has given best results under Wisconsin conditions.

Plant on well prepared soil. This gives the young plants good conditions for a vigorous start.

Cultivate the soil. This keeps the soil loose, kills weeds, and saves moisture.

Spray vines with arsenical poison and bordeaux for insects and diseases as needed. Timely and thorough spraying gives good results.

Rogue plants. Pull out any which are off-type or show degeneration troubles.

Handle potatoes with care. Every bruise means a chance for rot germs to enter.

Control Potato Diseases

THE WISCONSIN potato grower makes his greatest profit by growing potatoes which are free from disease. Through careful treatment of seed to prevent disease and proper spraying of the crop, much can be done to insure a heavy production of potatoes of superior market merit.

Since most potato diseases are carried by the seed, and, once in the soil, are persistent, only clean seed should be grown for the seed potato trade. There is a constantly increasing demand for good seed potatoes, not only in Wisconsin, but also from other sections, especially in the southern states.

To control potato diseases the symptoms must be recognized, the cause understood, and the proper remedy applied at the right time. Some diseases are produced by unfavorable weather or soil conditions, such as drouth, heat, frost, or lightning. These are called **nonparasitic** diseases. Many other diseases, such as scab or blight, are the result of bacterial or fungus parasites or germs. These are called **parasitic.** There are still other potato diseases of which the cause in unknown. These are herein discussed as **degeneration** or **virus** diseases.

Nonparasitic Diseases

Arsenical Poisoning

Symptoms. The leaves die, usually in spots, within a few days after paris green or other arsenical poison is applied.

Remedy. Use poison more judiciously. If paris green is used with water, add about one pound of lime for each pound of poison; if the poison is applied dry mix with air-slaked lime; if it is used with bordeaux mixture there is no danger of injury.

Sun Scald

Symptoms. Wilting and burning of the tender young leaves occurs in June and early July during very bright, hot weather and especially after a period of warm, cloudy weather. The youngest upper shoots suffer first and worst.

Remedy. There is no remedy, and since the plants usually recover quickly, little permanent injury results.

Tipburn, Hopperburn

Symptoms. During protracted dry, hot weather in midsummer, the leaves weaken and die, beginning at their tips and margins. The older leaves and those on the lower part of the plant suffer first and worst.

This is the most common trouble in Wisconsin potato fields during midsummer, especially on the earlier potatoes. Anything that weakens the plants or injures the foliage increases this trouble.

Leafhopper and flea beetle are the insects that, under Wisconsin

FIG. 1.—TIPBURN OF POTATO

The leaves die, turn brown, and curl up, beginning at the tips and margins. This is the commonest trouble in Wisconsin potato fields during dry, hot midsummer. It is often mistaken for early blight. When caused by leafhopper it is called hopperburn.

conditions, are most frequently associated with tipburn. The injury from leafhoppers has been so serious that it has been considered by entomologists as the chief, if not the sole, cause of much of this trouble. It is therefore well called "hopperburn" in such cases and is discussed in detail on page 17.

Remedies. Soil rich in humus, good surface cultivation to keep down weeds and check evaporation, thorough spraying with bordeaux mixture with the addition of insecticides (see page 17) to keep the foliage healthy, and very early or late planting of early varieties help to reduce tipburn.

Lightning Injury

Symptoms. Potato plants in a more or less circular spot in an otherwise healthy field suddenly collapse and die. The spots observed have varied from a few feet to several rods in diameter, and in most cases the injury has occurred in the first half of July. In typical cases the main stems are at once blackened and killed for some distance above and below ground, but the fibrous roots, young tubers and upper leaves may not show injury until this results from the dying of the stem. The spots do not increase much in size, and of course nothing can be done to lessen the injury after it has occurred.

Internal Spotting or Browning of Potato Tubers

The flesh of potato tubers often shows rusty brown or blackish spots or streaks, even when the tubers appear sound on the surface. There are various types of this trouble, none of which, however, represents a serious disease in Wisconsin. The more important types which have been found here are briefly discussed below.

Hollow Heart

This is the familiar condition where overgrown tubers develop a cavity in the center. This is not properly a diseased condition but it is, of course, objectionable. Closer planting tends to reduce it. The flesh immediately bordering on such a hollow heart will gradually die and turn brown. This should not, however, be confused with blackheart.

Black Heart

If potato tubers are heated to a little above blood heat for a day or more, they will generally begin to die and turn dark at the center. This central portion will soon become purplish black and later may crack open. While this condition may arise in storage pits closely covered by fermenting manure it is most commonly met in car shipments, in warehouse storage in winter where a stove is used to keep out frost, or in the bottom of very deep bins. It may also develop when

seed stock is exposed to the hot sun in the spring during preparation for planting.

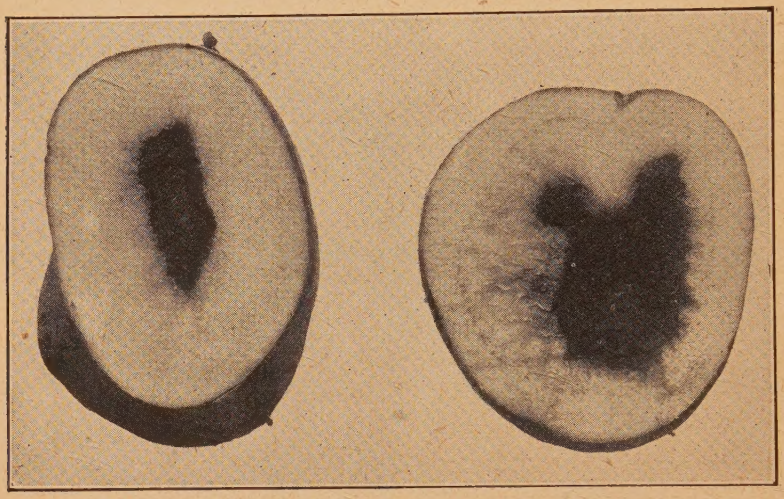

FIG. 2.—BLACK HEART

Black heart is caused by heating at about blood heat for one day. The interior cells die first and turn black. Compare with freezing injury where the ring of fiber bundles is the first to be injured.

Freezing Injuries

Exposure to low temperatures causes three kinds of injury to potatoes. (1) When potatoes are frozen solid they turn soft upon thawing. Field frosting where the side or end of the potato is exposed, is an injury of this kind. (2) Potatoes stored for a month or more at temperatures of 29° to 34° F. turn sweet without the production of ice crystals. Ice crystal formation and resulting injury is almost sure to occur if potatoes are handled while the temperature is between 29° and 31° F. (3) Internal freezing injury or "frost necrosis" occurs when tubers are exposed for a few hours to temperatures slightly below 28° F. The symptoms of this are greyish brown blotches or streaks on a slightly bluish background. Such chilling may occur at any time during handling or shipping, but the greatest danger is when the tubers are stored in field pits or during midwinter storage. In recently chilled potatoes there may be no indication of trouble on the surface.

Internal Brown Spot

Rusty brown spots from ⅛ to ½-inch in diameter are scattered irregularly through the flesh. The disease is neither common nor serious in this state. The cause is not known with certainty, but the disease is usually attributed to lack of potash or other food elements.

Certainly it is not parasitic or contagious and it is not carried from year to year in the seed; therefore, no remedial considerations are called for. This may be confused with freezing injury.

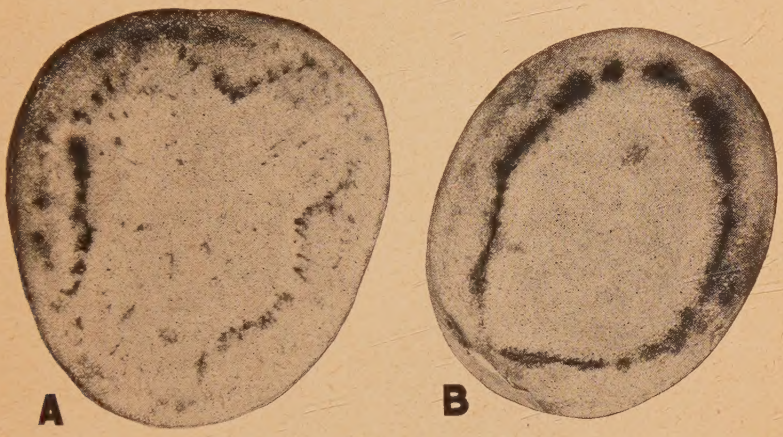

FIG. 3.—INTERNAL FREEZING INJURY

These tubers were exposed to 17 degrees F. for two hours. They did not freeze at the surface but were internally discolored. In A the vessels alone are injured showing as a network of dark lines in the flesh, net necrosis. Often, as in B, internal freezing injury shows as a dark ring which is not always complete but may be broken.

Stem-end Browning

Frequently upon being cut, especially if cut late in winter, potato tubers show a slight blackening of the veins penetrating the flesh from the stem end, and occasionally this will follow the veins through the flesh as brown streaks. In many cases this simply indicates a weak tuber which is losing vitality and dying first in these regions. In some cases, however, a similar symptom is produced by the fungus wilt disease, which is caused by a parasite carried in the seed. This disease is described on page 12. Potatoes showing such symptoms should, therefore, not be used for seed.

Parasitic Diseases

Common Potato Scab

Cause. Potato scab is caused by a parasitic growth on the surface of the tubers. The spores or germs are carried over winter in the old scab spots, or scattered in the dust from scabby potatoes which may cling to the surface of smooth tubers. The scab parasite persists in the soil many years after a crop of scabby potatoes. It will also pass

through the digestive tract of stock fed on scabby potatoes. The scab germ thrives best in an alkaline soil and is checked by acidity. Hence lime or ashes increase it, and plowing under green crops renders the

FIG. 4.—COMMON POTATO SCAB

There are other forms of potato scab and scurf, but this is the commonest in Wisconsin. In some of the blackest spots of this specimen insects have deepened the injury. Seed disinfection and clean soil are the remedies for this disease.

soil less liable to it. Dry soil conditions at the time of tuber formation tend to favor scab, while sufficient moisture will retard its development.

Minute insects, scab mites, and beetles often invade the scab spots and enlarge and deepen the injury. White grub and wire worm injuries may also be coupled with those of scab, but they have no regular association and are easily distinguishable.

Remedies. Select smooth seed potatoes; disinfect with corrosive sublimate or formaldehyde and plant on clean soil. The use of sulphur or inoculated sulphur on the soil before planting is advocated in some states but has not as yet been proved useful under Wisconsin conditions. Clover sod is best but any green crop, particularly fall sown rye turned under is helpful. Cook scabby potatoes before feeding to stock and do not use fresh manure on potato land or apply lime or ashes. Rotate potatoes with other crops, and if scab develops do not grow potatoes again on that soil for five years or more. The long interval between potato crops tends to starve the scab fungus because of lack of favorable food.

Other Diseases to Be Avoided

Two European diseases, powdery scab and wart have been found in a few fields in the eastern part of the United States, but have never been located in Wisconsin. It is important to keep our fields free and to that end the greatest care should be observed not to bring in seed from unknown or questionable sources. There is a federal quarantine against importing potatoes from any foreign country where wart is known to exist. Every man interested in potato growing should assist in maintaining this quarantine.

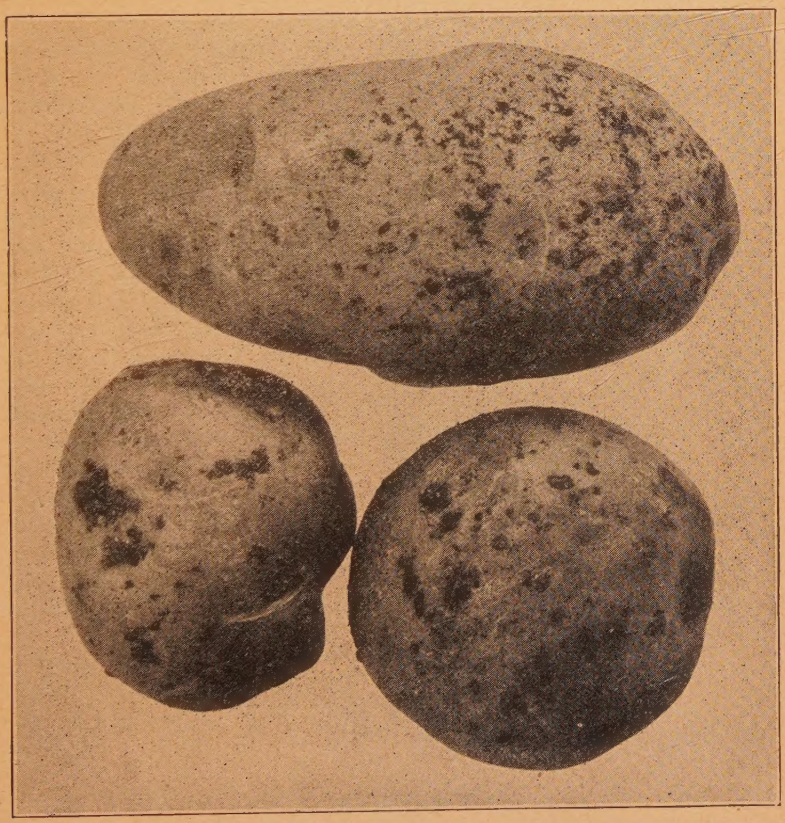

FIG. 5.—BLACK SCURF ON TUBERS

This disease is carried from year to year in this "dirt that won't wash off." Corrosive sublimate seed treatment is the best remedy.

Black Scurf

Symptoms. Black scurf often occurs on Wisconsin tubers. It appears as black specks or flakes on the skin like "dirt that won't wash off." It really is not dirt but a fungus growth on the skin of the potato. The greatest damage to the potato crop from the black scurf fungus is not to the tuber but to the young growing stems. The fungus frequently cuts off the stems before they break through the ground or may cause such serious brown cankers that the vitality of the plant is greatly reduced. The tuber-forming underground stems may be cut off, thus forcing an abnormal tuber development near the base of the stem or even in the axils of the leaves.

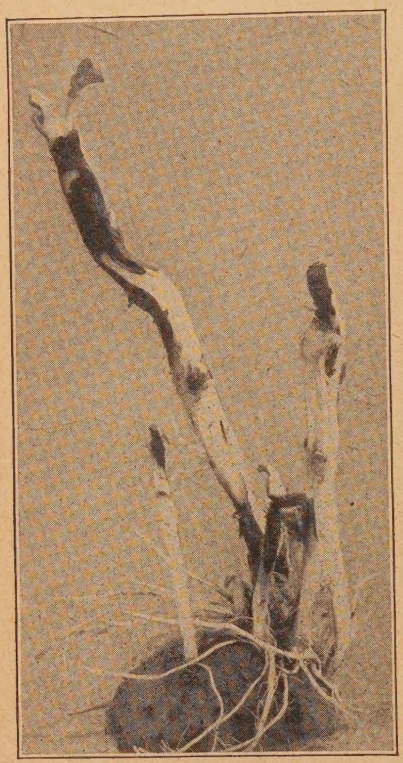

FIG. 6.—BROWN STEM CANKERS
The black scurf fungus, Rhizoctonia, attacks the stems and underground parts, causing these cankers. It frequenty kills all the young shoots causing missing hills. June is the month of most serious injury.

Remedy. Complete elimination of black scurf is very difficult because the fungus may live in the soil as well as be introduced with the seed tubers. Seed disinfection with corrosive sublimate (see pages 19-22) for details of treatment) and crop rotation are the best methods of control and under Wisconsin conditions are commercially satisfactory. The special benefit derived from treatment is the protection which it affords to the young shoots as they start. The treatment kills the disease producing fungus on the tubers and allows the young plants to grow without injury. Where the fungus comes from the soil it is usually later in the season so that the young growth is not injured.

Blackleg

Appearance. Blackleg is a bacterial disease carried on the seed tubers. It causes the seed to rot early, sometimes before the sprouts break through the ground, thus giving an irregular stand and weak plants. The rot then spreads up the base of the stem, which turns

black and rots as far as the surface of the soil or above. As a result of this, the plant stops growing and the leaves become pale and bend upward, giving the plant a sickly, narrow, and spindling appearance. Diseased plants generally die soon without setting any tubers.

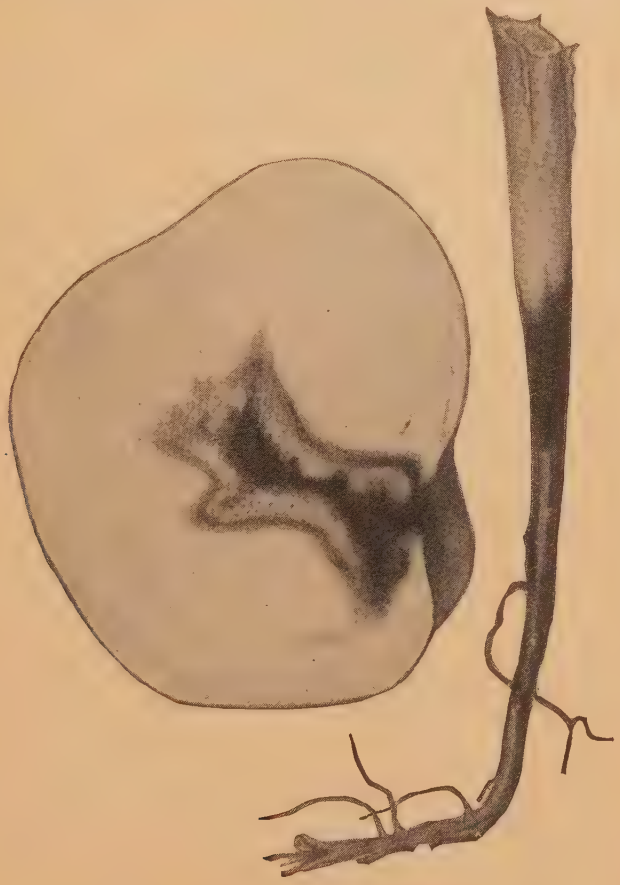

FIG. 7.—BLACKLEG

The old seed tuber rots, and from this the rot passes to the stem of the young plant which rots to surface of ground or above. If new tubers are set they may show soft rot in field after digging. As yet, this disease is not common in Wisconsin. Keep it out by removing diseased plants from the field.

The disease is worst in heavy moist soil, and in some cases, where it is bad, it may spread from the stem to the tubers causing a rapid soft rot. Although this disease is not yet serious anywhere in Wisconsin, it occurs widely, and steps should be taken to control it before it becomes common, especially where potatoes are being grown for seed purposes.

Remedy. This disease is carried on the seed and is controlled by selecting sound seed potatoes and disinfecting them as for scab or black scurf. In addition, it is well to pull up all diseased plants as soon as they are detected so that they will not form tubers which might contaminate the crop.

Wilt and Dry Rot

Occurrence. Farther south potatoes are quite subject to two types of wilt disease and apparently one or both of these may have a slight foothold in Wisconsin. They are, however, not common and not of economic importance except for those growing seed potatoes. The aim should be to recognize them and eradicate them whenever they are found. The symptoms are so similar that for practical purposes they may be considered together. They are characterized by a wilting and falling over of the vines of infected hills in midsummer, four to six weeks before the crop should mature. There is no blackening of the stems as in blackleg, although the stem sap vessels may have a brown color. When tubers are found on these plants they are likely to show a blackened stem end running for half an inch or more into the flesh, and in storage this may develop into dry rot proceeding from the stem end.

Control. Any suspicious looking wilting plants should be pulled or dug and destroyed whenever seen during the summer, and seed tubers showing suspicious blackening of the interior, especially at the stem end, should be rejected. In case quick wilting occurs in a field, crop rotation should be practiced, potatoes being kept off the soil for five years or longer.

Storage Rots

Storage rots frequently cause heavy losses in cellar and storehouse. In general they are of two types, dry and wet. The dry rot may be due to infection from the field diseases, wilt or blight, or it may follow bruising, especially if the tubers are dug when green, so that the skin is easily broken. Green potatoes dug with a machine suffer more injury than do ripened ones. Dry storage rot is often characterized by a white moldy growth on the surface and in the interior.

Wet bacterial rot, which has a very bad odor, frequently occurs when blighted potatoes are kept in deep piles or are put into storage without having first been dried out in small pits. This rot frequently follows injury from late blight rot, especially where the tubers are dug early and stored under warm, moist conditions.

Remedies. Handle potatoes carefully to avoid bruising. Keep the storehouses cool and dry. Do not cover pits with wet vines.

FIG. 8.—EARLY BLIGHT

Sharply defined dead black spots appear anywhere on leaf. Quite common in Wisconsin potato fields in August and September, especially with early varieties on lighter soils. It can be prevented by spraying.

Early Blight

Occurrence. This fungus disease, common in Wisconsin, causes black spotting of the leaves in late summer but does not attack the stem or tuber. As these spots enlarge and merge, the entire leaf may be killed prematurely. The disease is worst on the lighter sandy soils and on early varieties, in which cases it may reduce the yield from 10 to 25 per cent.

Remedy. Spray with bordeaux mixture three or four times at intervals of about two weeks during the latter half of the summer. Since the fungus lives over winter on old vine refuse, it is important to rotate crops.

Late Blight and Rot

Occurrence. As indicated by the name, late blight and rot causes the tops to blight in late summer and autumn, and this is followed by rotting of the tubers either in the field or in storage. It develops only during moist weather. Under certain conditions it is the most destructive of all potato diseases. In northern New York, New England, eastern Canada, and northern Europe, it is common in wet seasons, especially on the heavier soils, and in bad years it may destroy 50 per cent or more of the crop. It was this disease which caused the Irish famine in 1845. Fortunately, it is not generally destructive in Wisconsin. In 1902-1904 and in 1914-1915, however, it was widespread throughout the state and caused general blighting of the tops, followed by much rotting of the tubers. Since that time there has been no serious epidemic until 1919, when this disease was again prevalent in certain localities. The disease is apparently present every year, in a small way at least, in the cooler, moister regions of northern Wisconsin, and the extent of its development is simply dependent upon favorable weather conditions.

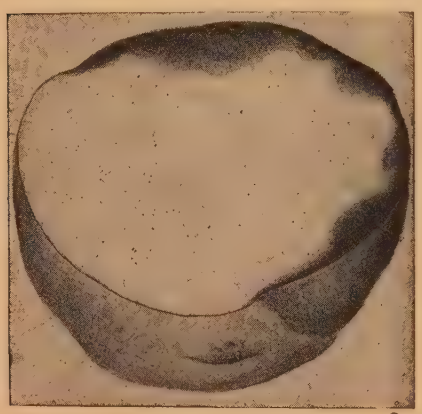

FIG. 9.—LATE BLIGHT ROT

The rot appears as dark sunken places on the skin with the flesh underneath browned to a depth of perhaps a quarter of an inch. These start mostly on the upper side of the tuber before digging, from spores washed into the soil from the blighting leaves. Control by using bordeaux mixture on the vines. Dry storage helps.

Remedy. Do not knowingly use seed tubers from fields where late blight has occurred. Spraying with bordeaux mixture as for early

blight will control this disease, especially if the spraying is thorough and aimed at covering both sides of the leaves. More frequent applications than for early blight may be necessary in case of excessively rainy weather. If the tops are killed by late blight, do not dig the tubers until a week or more after the tops die, and then place at once in cool storage to reduce the danger from rot.

Degeneration or Virus Disease

There is no group of diseases that is of greater menace to successful potato growing in Wisconsin than the group of degeneration or virus diseases which includes mosaic, leaf roll, curly dwarf, and spindle tuber. A strain or variety which is commonly spoken of as "run-out" may exhibit one or several symptoms associated with these diseases. They are all alike in that the definite cause or virus is unknown and also in that the causal agent, whatever it may be, is capable of being transmitted from plant to plant by lice and possibly by some other insects and of being carried from year to year in the seed tubers.

Mosaic

Symptoms. Mosaic is the most common degeneration disease in Wisconsin potato fields causing considerable loss particularly to Triumph and Green Mountain. The characteristic symptoms of mosaic are that the leaves are more or less crinkled and may be mottled with irregularly distributed yellowish spots occurring between raised portions of the leaf that are darker than normal. Temperatures above 75° F. favor the masking of mosaic. Hence during the hot weather of mid-summer the mosaic symptoms may become less visible so that it is impossible to tell definitely whether the disease is present or not. On the other hand, a temperature of 60° F. tends to bring out mosaic, which explains the greater amount of this disease in cool seasons. In severe cases the plants show a decided dwarfed appearance. The yield from infected plants may be reduced from 10 to 80 per cent.

Spindle Tuber

Symptoms. Plants which show the spindle tuber condition are characterized by having tubers generally more cylindrical, more spindle shaped, with more numerous and conspicuous eyes. This condition is causing considerable damage in some strains of Green Mountain and persists from year to year regardless of seasonal conditions. It is understood that seasonal conditions may also have an important influence on the shape of the tuber, especially in the Rural New Yorker group.

FIG. 10.—POTATO MOSAIC

The leaves are crinkled and mottled light and dark green. The mosaic plants are often much smaller than healthy plants.

Leaf Roll

Symptoms. Leaf roll is a condition where the leaves are quite tough and roll upward from the outer edges. It is of much less importance in Wisconsin than mosaic or spindle tuber.

Remedies

There is no specific remedy for this type of diseases. Since they are carried with the seed, the chief way of avoiding them is to use only seed from healthy plants. The best way is to get certified seed. If there is only a small or moderate amount of degeneration trouble

present, it may be possible to rogue out the diseased plants. But since the virus may be present in the plant without any visible symptom, it is practically impossible to rely entirely on roguing. In any case the roguing or pulling out of diseased plants should be done as soon as they appear. This may be done most easily by maintaining a seed plot, preferably separate from the rest of the field.

The control of plant lice and other insects is another important way of keeping the degeneration diseases under control. Spraying with nicotine sulphate "Black-leaf-40", ½ pint to 50 gallons spray is the best control for lice.

The use of Wisconsin inspected (certified) seed potatoes is especially recommended. This seed can be obtained from growers whose stock has been carefully inspected for these troubles both in the field and bin. While this inspection is not an absolute guarantee, the results from certified seed show a marked decrease in the degeneration troubles described.

Potato Insects

Colorado Potato Beetle

Common potato beetles are probably the most generally injurious pests of the potato. The most important treatment for the season consists of early spraying with arsenical poisons. Thorough control of the first brood hatching on the potato plants, just as they appear above the ground, is most important. At this time, a small amount of poison, properly applied, destroys the beetles and young larvae. Isolated fields, planted late, often escape serious injury.

Flea-Beetle

These tiny black beetles about the size of a pinhead often appear in great numbers in midsummer and later. Their attack on leaves soon riddles them with tiny round holes about 1/16 of an inch in diameter. Seriously damaged leaves soon dry out or turn brown at the tips. Potato blight may be distributed by the flea-beetles.

Remedy. The bordeaux-arsenical mixture is generally an almost perfect control for flea-beetle injury. Early varieties are preferred to late varieties by this pest.

Leafhopper

These insects have caused serious damage to Wisconsin potato fields in recent seasons. They are light green in color and obtain their food by sucking the juices from the veins of the leaves. The mature hoppers puncture the veins and insert their eggs. The young insects remain on the leaves where they were hatched until they are mature, but the full-grown ones are very lively and fly or hop from plant to plant,

hence their name. Injured leaves are characterized by a marked upward curling and dying of the tip beyond the point of greatest injury. It is spoken of as "hopperburn."

Remedy. Bordeaux mixture thoroughly applied is the best control known for leafhopper. The three to five applications necessary should be made under high pressure with nozzles so directed that the spray will reach both sides of the leaves. This is highly important, as simple down spraying is less efficient in reaching the undersides of the leaves where the hoppers work.

Grasshoppers

Considerable damage to potato fields is often caused by migrating swarms of grasshoppers living on meadows after harvest. This is particularly true when the weather is hot and dry so that other green food is not available. Not only the potato tips, but often the stems also, are seriously injured by grasshoppers.

The bordeaux-arsenical spray is effective in preventing injury from these insects, but a better control for grasshoppers is the use of poison bran mash made by stirring one pound of paris green or white arsenic and one pound of salt into 25 pounds of dry bran. This mixture should then be moistened with 2 or 3 gallons of water into which has been added 12 teaspoonfuls of banana oil. Use water enough to make the bran crumbly but not sloppy. By scattering this poisoned mash in the path of the grasshoppers or in adjacent fields it is possible to prevent their swarming onto the potato fields.

Potato Aphid

Frequently the pink and green aphids of potato occur in such numbers that control measures are advisable. Particular significance is attached to their presence, since they are now known to be an important factor in the distribution of leafroll and mosaic of potato.

Remedy. If control is necessary, nicotine sulfate should be added to the bordeaux-arsenical mixture, at the rate of about ½ pint of the sulfate to 50 gallons of the spray.

Tobacco Horn Worm

In addition to the insects mentioned the tobacco horn worm occasionally appears in serious numbers. This has been the case locally during recent years. It is a green worm the size of one's finger when mature. It is easily controlled by bordeaux-arsenical sprays, especially if these are applied in early summer, when the worms are small. If the worms are numerous and large, hand picking may be worth while.

Control of Potato Diseases

Soil and its Fertilization

The potato crop is especially sensitive to soil conditions, certain types of soil predisposing it to disease. Certain diseases, as already explained, may be carried in the manure or perpetuated in the soil; hence the importance of attention to soil and fertilization.

Soil. A sandy or gravelly clay loam is the best soil for potatoes. In any case avoid heavy wet soils or clays that cannot be properly drained.

Rotation. Rotate with other crops, planting potatoes not oftener than once in three years. Potatoes, grain, and clover make a good rotation.

Fertilization. Do not use fresh horse manure on potato land, or manure from other animals fed on diseased, uncooked potatoes. Do not use lime or ashes on potato land. Turning under a green crop, such as rye or clover sod, is the ideal preparation for potatoes.

Seed Selection

Source of seed. Avoid using seed potatoes from fields or crops that suffered badly from diseases known to be carried with the seed; that is scab, blackleg, late blight, wilt, and the various types of rot.

Imported seed. Seed potatoes should not be imported from foreign countries, especially northern and central Europe, nor brought in from sections of the eastern part of the United States, because of the possibility of bringing in powdery scab, wart, or other trouble not known to occur in Wisconsin.

Sorting seed. Sort carefully just before planting, and use only clean, sound, smooth tubers for seed.

Discolored flesh. When cutting tubers for planting, one should keep a careful lookout for any showing discolored flesh. Badly discolored potatoes should be thrown out and not used for seed. If seed is scarce or high-priced and the discoloration is slight, especially if it is closely confined to the stem end, the tuber may be used, provided such discolored part is cut off and rejected.

Disinfection of Seed Potatoes

The germs of scab, black scurf, and blackleg should be destroyed by seed treatment or by seed disinfection. They may be carried on the surface of tubers taken from a diseased crop, even though these tubers themselves appear to be smooth and healthy.

All seed tubers from unknown sources or from fields not known to be free from disease, especially if from the East, should be disinfected. It is a simple, inexpensive and harmless precautionary

measure. There are two standard solutions, formaldehyde and corrosive sublimate, of which corrosive sublimate has given better results under Wisconsin conditions.

Formaldehyde. *Cold Solution.* Soak seed potatoes two hours in a solution of 1 pint of formaldehyde (40 per cent) in 30 gallons of water. The same solution may be used repeatedly without deterioration.

Hot Solution. Soak seed two minutes in a solution of 1 pint to 15 gallons of water at a temperature of 118° to 122° F. Remove tubers from solution, drain liquid back into treating tank, set tubers aside in pile and cover with blanket or canvas for one hour. This method has been devised and recommended in Iowa. Formaldehyde is not as efficient as corrosive sublimate, but it is cheaper, and it is harmless to metal tanks and stock.

Corrosive sublimate, also called mercuric chloride, dissolved at the rate of 1 part to 1,000, by weight, in water is more effective than the formaldehyde solution but has the drawback of being **very poisonous.** The sublimate can be secured either in tablet form or in bulk. It is colorless, tasteless, and odorless, and **if carelessly exposed it is likely to be mistaken for water.** Dissolve the tablets as directed, or dissolve 1 ounce in 1 quart of hot water and make up to 30 quarts (4 ounces to 30 gallons). Soak the uncut potatoes 30 minutes to 2 hours depending on their condition and the time of year.

1. Unsprouted seed with small amount of black scurf or scab, soak 30 minutes to 2 hours; 1½ hours is recommended.

2. Unsprouted seed with large amount of black scurf or scab, select best and soak 2 hours.

3. Sprouted seed showing small amount of black scurf or scab, soak 30 minutes.

4. Sprouted seed showing large amount of black scurf or scab, discard and obtain healthy seed, preferably Wisconsin certified.

This solution decreases in strength with use. To correct this add ½ ounce of chemical for every 4 bushels treated. Keep the amount of water up to its original volume. The amount of chemical to be added after each use of the solution is based on the 1½-hour soaking. Throw away the solution after it becomes very dirty. It is usually good for seven or eight lots.

A more exact method for determining the strength of the corrosive sublimate treating solution is to use the potassium iodide test. The reading of this test will indicate the amount of corrosive sublimate to add after each treatment to bring it up to standard strength—1 to 1000. This test in brief is as follows: Take 25 cc. (cubic centimeters) of one half per cent potassium iodide solution in a tumbler. Then measure out in a 100 cc. cylinder or measuring glass 100 cc. of corrosive sublimate solution to be tested and add it slowly to the potassium iodide solution. At first a yellow cloudiness will form which will clear up on shaking. Finally the cloudiness remains permanent. A

pink or purple color may be present depending on the amount of dirt in solution. A test of the original solution before treating will give a standard of comparison for subsequent tests. The correct end point is reached when 50 cc. of corrosive sublimate solution of standard strength have been added to the potassium iodide. If more than 50 cc. is required, then the solution is weak and must be strengthened by adding small quantities of fresh chemical.

CORROSIVE SUBLIMATE POTASSIUM IODIDE TEST*

Solution used in cc.....	50	55	60	65	70	75	100
Corrosive sublimate in ounces to add to 30 gallons solution	0	.4	.7	.9	1.1	1.3	2.0
Corrosive sublimate in ounces to add to 100 gallons solution	0	1.2	2.2	3.1	3.8	4.3	6.7

*This table of additions was worked out by F. M. Blodgett of Cornell University, and has given satisfactory results.

In adding corrosive sublimate in tenth ounce quantities it is most convenient to dissolve one ounce in one liter (one quart jar) of water, when 100 cc. will represent 1 ounce. A 25 cc. and a 100 cc. measuring cylinder will be needed in making this test. It is especially applicable to large operations and community treating tanks.

Another method of handling the 1-1000 corrosive sublimate treatment is to treat the first lot of seed 1½ hours and to increase the time of soaking the second lot of seed to 1¾ hours, and the third lot to 2 hours, instead of increasing the strength of the solution. After the solution has been used three times it should be discarded because of decrease in strength. This method is more expensive in chemical used, is less efficient, and takes more time, but has the advantage of being less trouble and is frequently preferred by farmers who treat a small amount of seed.

Use hose, sprinkler, pail or dip in water to wet the tubers all over, then keep covered for 24 hours before treating. This wetting allows the fungus to start and makes the treatment more effective. The time of treatment may be shortened to 30 minutes to one hour when wetting has been done.

The practice of treating the seed loose in barrels or tanks is especially commended. Galvanized iron stock-watering tanks may be used if they are first carefully painted wth asphaltum paint. Otherwise, use wood or cement tanks, as metals are corroded. When barrels are used, have them on a platform so that the solution can be drawn off into a pail or tub. Do not treat the potatoes in dirty sacks, since the latter absorb corrosive sublimate and thus rapidly reduce the strength of the solution.

Treat tubers while they are dormant, if possible, and at least 10 days or 2 weeks before planting. They may be treated any time from

November to May, but the objection to treating in winter is the difficulty of drying.

Tubers should be dried **immediately after treatment.** If possible, treat potatoes on a clear drying day and without rinsing. But in case of cloudy or damp weather, when a concentration of the chemical in the eye pockets might cause injury, potatoes should be rinsed in clear water after treatment. Do not make big piles of wet tubers, as injury is likely to result. Potatoes should not be used for food after this treatment. After treating in late spring avoid exposure to hot sun, since this causes blackheart and otherwise injures the seed stock.

Spraying Potatoes

In spraying plants, as in most other matters of plant culture, judgment based on experience is necessary for the best success. The following directions are written with the idea of giving any practical potato grower such advice as will enable him safely to begin spraying operations. Careful study of his own conditions will then soon enable him to adapt the methods and dates of spraying to his own particular needs.

Early applications. As soon as the eggs of the first potato bug (Colorado beetle) hatch, make an application of an arsenical poison alone or with half-strength bordeaux mixture, that is 2-2-50. **Promptness in early spraying is the thing of chief importance.** The poison may be applied either wet or dry. The standard treatment is an application of paris green either in water, or dry and diluted with air-slaked lime or land plaster (gypsum). One or two pounds of the poison diluted with 50 gallons of water, or six pounds of dry powder is the standard application for each acre. The use of either zinc

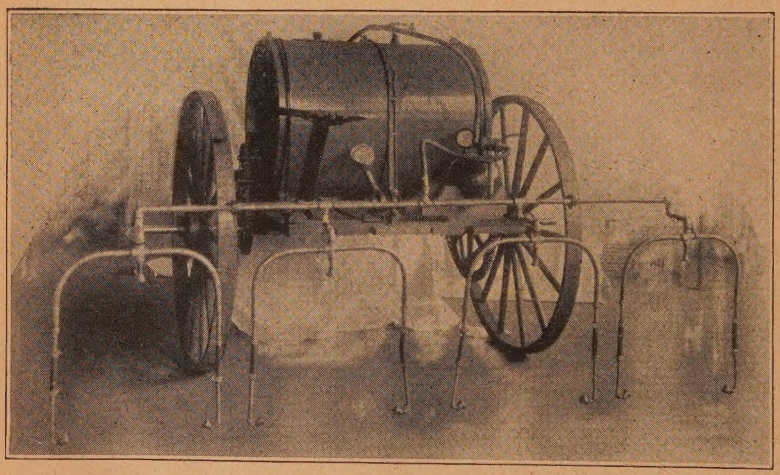

FIG. 11.—A FOUR-ROW POTATO SPRAYER

A good sprayer should cover the vines thoroughly with spray, and keep up high pressure. Two or three nozzles to a row are better than one.